**Meeting the demand for meat – analysing meat flows to and from the UK pre and post Brexit.**

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**KEYWORDS**

Meat; Global trade; Brexit; Food security; Food regulation

**ABSTRACT**

*Background:* Global trade has grown at twice the rate of the economy since the 1990s. Today’s food system is a complex network of trade dependencies and supply chains which underpin global food security. International trade is a crucial element in providing UK consumers with meat-based produce in their diet. The international meat trade was estimated at $112.5 billion (£74.25 billion or €104.10 billion) in 2015 and UK imports are worth over 5% making the UK the 5th largest market. Understanding how Brexit might alter the landscape for UK meat imports is an important socio-economic issue.

*Scope and approach:* Data was analysed from the Chatham House resourcetrade.earth database, which is open access and collated from a range of global sources, allows analysis of data for imports into the UK of beef, pork, lamb and poultry and of exports of these meat types from the UK have been completed using R-studio statistical package.

*Key findings and conclusions:*  The UK’s global market significance in each meat type ranges from 3% in beef to 9.9% in sheep, and most imports originate from the EU especially Pork (99.8% from EU) and Poultry (95.5%). Analysis of the Food Safety QUAD countries (USA, New Zealand, Canada and Australia) highlights that the USA has capacity to cover any loss of imports to the UK from Europe post Brexit, with New Zealand and Australia being able to replace the 11.1% of lamb, which comes from the EU. The Rotterdam Effect is also explored highlighting how countries like Thailand and Brazil may offer future imports of poultry and beef if trade with EU becomes disrupted.

**HIGHLIGHTS**

* Global food trade for meat: important for domestic food security
* UK is the fifth largest meat importer in the world
* The EU provides most of the meat imports to the UK
* QUAD food safety countries have the capacity to provide meat to the UK

**1 Introduction**

The Global Enabling Trade report published by the WTO in 2016 highlights how global trade has grown at twice the rate of the global economy since the 1990s1. Global trade of food is diverse and complex and a system in which most countries strive to participate since it often underpins international and national food security2,3. It is argued that millions of people’s food security is heavily reliant on the evolution of global trade2 as autarky would not be an optimal risk strategy for food security. However, there are many academics researching the food system whom argue that trade is an important factor helping create a failing and unsustainable globalised food system4**.**

Between 2000 and 2015 the volume of agricultural commodities traded on international markets increased by 127% to 2.2 billion tonnes2. Global exports of food commodities were worth about US$522 billion per year in the period 2000-2009. This corresponds to 26% of world gross agricultural production, based on farm gate prices 5 . Trade also represents a sizeable fraction of global food production, with 2.6 ­quadrillion calories traded globally, or more than 20% of global calorie production5,6.

The UK has been an important participant in the Global Food Trading system, although most of its imports and exports have been with members of the European Union, with the top 8 exports all to the EU, with the exception of the US which is second in terms of value5. In contrast, our top 8 imports are all from the EU, with the USA being ninth5.

International trade has been critical in providing UK consumers with meat-based produce in their diet and it is hard to envisage change in the livestock industry within the UK being able to significantly reduce a need for trade. DEFRA found that in 2014 we produced 84% of the meat we consumed with 16% dependent on international trade7 . We use the Chatham House resourcetrade.earth 8 to analyse which countries are/may be involved in current and future meat imports to the UK.

International trade makes up a significant share of the UK’s current meat consumption, resulting in the UK’s meat consumption representing a significant share of the global trade in meat. The total value of meat traded internationally in 2015 was estimated at $112.5 billion. The UK as an importer of meat makes up for a large share of this trade. Figure 1a shows the UK’s meat imports in 2015 are roughly worth 5.3% of the total international meat trade: the 5th largest globally. A significant share especially considering the UK’s population is only 0.87% of the world’s population. The UK import market’s significance in each individual meat market ranges from 9.9% of sheep meat trade to 3.6% of cow meat trade8. In fact, the UK’s least relatively valuable import market – beef – was subject to fraud in 2013. Without the capabilities to identify and disrupt fraudulent activity, the UK was in a vulnerable position.  The driver was not the overall value of beef traded across the EU, as only a relatively small proportion of the market was, but the significant differential in price between beef carcass meat and horse carcass meat and the ease of substitution once meat was processed further than primary cuts and the following palletisation process. This led to the Elliot review in 2014 and the establishment of a National Food Crime Unit in the UK. Food fraud is a complex problem and the NFCU report10 offers the current status in the UK, but it’s not easy to predict whether larger or smaller markets are more vulnerable to fraud which is also coupled with regulatory, inspection and detection capabilities.

**2. Methodology**

The source of the raw data is from the Chatham House resourcetrade.earth8 a repository of statistics on bilateral trade in natural resources between more than 200 countries and territories. The database includes the monetary values and masses of trade in over 1350 different types of natural resources and resource products. It contains raw materials, intermediate products and by-products.

It is based on the International Merchandise Trade Stats (IMTS) which are based on the UN Commodity Trade Statistic Database (UNComtrade) which is itself founded on other sources including from the UN FAO, the EUROIND. Through cross-referencing and standardisation, the database has the best balance between completeness and detail of all available trade flow databases and it addresses many of the challenges faced by people trying to use UNComtrade, especially since it reorganizes data around natural resources and it employs a systematic approach to identify and manage data gaps and errors1.

The raw data available from the resource trade database has been processed to give the statistics using the statistical programming language ‘R’ on the integrated development environment ‘RStudio’. All the statistics have been calculated using the value measurements of trade flows as opposed to weight measurements. If statistics were reproduced using the weight measurements these were found to convey the same message from the charts produced using value measures.

The four categories of meat specified in statistics and general comments are specified by the contents of each category in the resource trade database “beef”, for example, consists of bovine carcasses, cuts, edible offal, tongues, and livers. Likewise, pork, and lamb/sheep meat, consist mainly of meat solely from pigs and sheep respectively. Poultry consists of edible meats from chicken, turkey, ducks and fowl. One area of ambiguity is the inclusion of cured bovine meat in the pork section, however this is only a minor section of total trade and so, not a significant issue but highlights why the new database has advantages as it offers more clarity about what is included in global trade data.

**3. The significance of the EU as a source for UK meat imports**

As a share of the total value of meat imported into the UK in 2015 the four largest sources are all from the EU: Figure 1b shows that 23.3% of imported meat originates from Ireland, 22.1% from the Netherlands, 8.74% from Denmark, 8.34% from Germany. Taken as a whole the EU dominates all but one of the key meat types. Of UK beef, poultry, and pork meat imports 86.2%, 95.5%, and 99.8% are imported from the EU respectively (see Figure 2). The only market not dominated by the EU, sheep meat, imports 11.1% of its meat from the EU. These figures for meat offer granularity to the overall import picture highlighted in the FAOSTAT5 showing that the top 8 importing countries to the UK are EU countries.

This data points to the EU currently dominating the international supply of meat to the UK, most markedly for poultry and pork. This domination makes the consequences of changes in trade relationships with the EU upon UK meat imports an area which needs consideration as to how to close any gaps which may arise and is unpacked further by our research.

***4 Where might future trading relationships emerge to replace any reductions from the European Union?***

Any trade barriers that might occur and how these might restrict imports will depend on the outcomes of negotiations. The House of Lords European Union Committee has suggested that there are four different trade relationships available after exit11. The first is partial access to the single market via membership of the European Economic Area (EEA), the second is access to the EU Customs Union (EUCU), as Turkey has, the third is a free trade agreement (FTA) with the EU, as Canada has, and the final option is trade under World Trade Organisation (WTO) rules. According to the Parliamentary Office of Scientific and Technology, the 2015 government had ruled out the first two options12.

The current UK position, which will be voted on in the UK parliament in January 2019, is the UK withdrawal agreement which was published in Nov 201813. The key components of this agreement are:

1. The whole of the Uk will remain within the EU customs union.
2. Northern Ireland will remain within the single market.
3. There will be no fixed end date to that agreement.
4. The Brexit transition period can be extended beyond 31 Dec 2021, if there is still no agreement on a future relationship.

In terms of goods such as meat the following would apply:

●  Comprehensive arrangements creating a free trade area combining deep regulatory and customs cooperation, underpinned by provisions ensuring a level playing field for open and fair competition.

●  Zero tariffs, no fees, charges or quantitative restrictions across all goods sectors, with ambitious customs arrangements that build on the single customs territory provided for in the Withdrawal Agreement.

●  Extent of the United Kingdom’s commitments on customs and regulatory cooperation, including with regard to alignment of rules, to be taken into account in the application of checks and controls at the border.

In these times, government objectives could change but for now we assume that there will be a choice between the PM’s and EU’s withdrawal agreement described above or a baseline WTO trading relationship, known as “crashing out without an agreement, at least in principle. There will be the opportunity for future trading arrangements with countries outside the EU and FTA’s where appropriate but these would all need to be negotiated which would take time and it is hard to predict the short term let alone the long term dynamics of a future system.

Employing a WTO trading relationship would incur large rises in the price of meat. The FTA has been projected to incur trade facilitation costs of around 5% of the original cost, whilst the WTO arrangement, with its very high tariffs on meat, would increase prices by around 8% for all meats14. Both scenarios will increase costs, but the WTO would increase costs more than the other.

The statistics suggest that, whilst particular member states are somewhat dependent on the UK for business, they are far less dependent on our demand than we are on their supply.

Figure 3a shows the disparity on dependence. For example, whilst 47% of our poultry imports are sourced from the Netherlands, this accounts for 30.9% of their poultry exports. Likewise, whilst 66% of our beef imports come from Ireland, this accounts for 48.9% of their beef exports. Despite this disparity between demand and supply, it is undeniable that some of these countries are still dependent on our demand for their industries, particularly in beef and poultry, the effect that lapsing into WTO rules instead of a World Trade Agreement (WTA) would have on the Irish beef exporters, half of whom depend on our custom, or Dutch poultry exporters, almost a third of whom get business from the UK, could be damaging. Consequently, these countries may consider a FTA in beef or poultry, although the extent to which one member country in a union of 27 countries can push this through is questionable: Additionally, while the UK is heavily dependent on the EU for pork imports (99.8%) (Figure 2) no one member state particularly relies on the UK for custom; our largest partner, Denmark, sells only 15.9% of its exports to the UK (Figure 3a). This means that the likelihood of no FTA in the trade of pork is probably greater.

Even if an FTA is agreed it will take longer than the two years before the UK must leave the EU as the Committee has suggested12,perhaps meaning an interim period of trading under WTO rules, unless transition arrangements can be agreed on. Additionally, an FTA isn’t a total solution as prices are still predicted to rise by around 5% as earlier mentioned. Recent analysis by the Institute of Fiscal Studies has proposed that as 30% of food is imported to the UK from Europe compared to only 17% of overall consumer spend, This means that changes in the costs of imports – for example, through changes to tariffs or movements in exchange rates – are likely to have a particularly big impact on food prices.

An NFU study suggests that price increases will increase domestic supply, allowing the gap in demand and supply to be somewhat filled and price inflation staved off: “disruption of the industry’s supply may be smoothed if UK farmers expand domestic production in response to an upward trend in farm-level prices”14. However, exiting the EU will produce barriers to domestic expansion that may make domestic supply seriously inelastic to price increases. The Agriculture and Development Board notes that the nature of meat processing work, being ‘low-paid’, ‘irregular’, and ‘unattractive’, consequently employs a large number of migrant workers from Central and Eastern European countries – 38% of those employed in general ‘manufacture of food products’ are migrant workers16. Although it is possible for a free movement agreement to be maintained, political circumstances may make this very unlikely. Increasing productivity of existing workers or automation could help increase production without increasing migrant workers but this will take time and so in the short term, UK meat processors will be unlikely to be in a position to fill the gap left by EU imports. Probably at least as large a barrier is caused by the lead-in times for productivity expansion, whether the 18-36 months needed for beef cattle to mature, or the years it would be likely to take for planning applications for new poultry sheds to pass through the system.

The UK could redirect its own exports to domestic consumers. However, this is unlikely as UK exports include many cuts of meat that are not popular for UK meat consumption (e.g. snouts and trotters). Even assuming that all the meat the UK exports is perfectly substitutable for our meat imports, UK exports would not be able to cover the meat imported from the EU.

In conclusion, DEFRA defines one of the key features of food security as ‘affordability’17 and the World Health Organisation emphasises the need of ‘availability’ and ‘adequate income’ for nutrition. Any increase in food prices will be particularly bad for low income families whose spending on food makes up for a larger share of their income15.

Whilst there are a number of avenues to which a post-Brexit rise in meat prices may be ameliorated, like an FTA with the EU, increases in domestic production, reductions in exports, consumer reactions, all of these options have major limitations as mentioned above.

It seems apparent that a rigorous assessment of non-EU nations as candidates for new trade agreements in meat trade could be the only way to avoid any decline in supply/demand of meat for UK consumers. External producers of meat are known for often producing meat for much lower prices that EU producers, an EU report produced a theoretical example of producers from within the EU and outside, and with beef, pork, and poultry, the external producers sold for much cheaper than in the EU, meaning even a trade agreement that left some tariffs intact would still maintain the prices currently enjoyed today18.

***Future supply– new partnership?***

In order to avoid a rise in the price of meats, new import markets may need to emerge and here we identify countries who currently export large quantities of meat– in other words, growth opportunities. The analysis of whether these opportunities are suitable in normative terms will be evaluated later, as this section is strictly looking at quantity/supply. We take two approaches to narrowing down the number of countries analysed for meat trade flows: one is looking at the QUAD food safety countries and the other is looking at current major trading partners with the EU.

The QUAD Countries can be considered to be economically large members of the Anglosphere: Canada, New Zealand, Australia, and the United States of America. These four countries are good candidates for growth opportunities since the UK has many shared approaches and systems for example, in terms of meat production and standards.

Figure 3b considers each country as a candidate for replacing the deficit left from a loss of trade with the EU. By looking at how much a country exports to countries other than the UK, we can evaluate how much trade they could redirect to us following an FTA. This is potentially more useful than focussing on total production since many countries may produce much but lack the infrastructure to internationally export that product. For beef, whilst all the countries individually could redirect their trade to fill the trade gap left by the EU, it appears that Australia and the US are the main candidates for replacement. For pork, Canada and the US look promising and for sheep meat, New Zealand and Australia could comfortably replace the EU. Finally for poultry, only the US appears to be capable of filling any reduction in EU trade.

Whilst it appears that we import large amounts of meat from the EU, most notably Ireland and the Netherlands, some of this meat originates from countries external to the European Union. Much of the meat externally imported into the EU will make stop offs at other ports in the EU before being shipped to the UK. On the books, the incoming meat will be sourced from the last port of call but much of this meat comes from outside the EU. This phenomenon is named ‘The Rotterdam Effect’19 after the port of Rotterdam where large quantities of non-European meat travels through before reaching the UK. This means that there will exist a whole range of countries external to the EU, that have meat standards similar to ours and currently meet EU standards hence the arrival into Europe through Rotterdam. By directly trading with them, we could cut out the middleman of EU states like the Netherlands, whilst maintaining the meat standards that we enjoyed importing from the EU.

Looking at the principal sources for imports by the Netherlands, i.e. sources that may end up in the UK after stopping in Rotterdam, we find a number of large exporters to the Netherlands from outside the EU are primarily located in Latin America. In the case of beef, a number of sources are major exporters to the Netherlands. Figure 4a shows Brazil, Argentina and Uruguay all as major exporters along with all four of the Food safety QUAD countries. For poultry Figure 4b shows Brazil, Ukraine and Thailand as major exporters to the Netherlands. However, Ukraine may not be an appropriate candidate for a non-EU trading partner since it is, currently entering the Deep and Comprehensive Free Trade Area20. This analysis, therefore, shows Brazil as a potential partner for beef and poultry, Argentina, Uruguay for beef alone and Thailand for poultry.

Comparing exports from these countries to our import of EU produce in figure 5, as we did with the Food safety QUAD countries, highlights that Thai poultry and Argentinian beef exports do not have the capacity to completely replace any shortfalls. However, since we could source our food from a number of alternate countries, we will include them as a growth opportunity as they could offer a significant opportunity to fill any shortfalls. However, these imports are unlikely to be equivalent to what the market currently provides to consumers – Thai and Brazilian poultry imports are largely frozen or cooked/processed meat while UK consumer demand is overwhelmingly for fresh poultry, and similarly Argentinian beef is largely processed (e.g. corned beef) too.  This is not to say that substitution is impossible, but it would need a change of consumer preferences and/or a change in regulation (e.g. to disapply the EU poultry meat marketing regulations and allow in the UK as previously the sale as fresh of poultry that had been previously frozen).

So, this analysis has concluded that growth opportunities for the products we are looking for are as follows. For pork: Canada and the US. For poultry: Brazil, Thailand, and the US. For beef: Australia, Argentina, Brazil, Uruguay, and the US. Finally, for sheep meat: Australia and New Zealand.

***Assessing new partners for the UK***

Simply signing FTAs with these growth opportunities won’t simply solve our food security problems. Solving the problem of quantity of supply by signing a FTA with an ill-advised partner could potentially generate a problem with the quality of supply. As the University of Sussex report “A Food Brexit: time to get real” raises: “There are also serious risks that standards of food safety will decline if the UK ceases to adopt EU safety rules, and instead accepts free-trade agreements with countries with significantly weaker standards”21. There are a number of normative factors that will affect each country’s suitability as a new source for UK meat consumption. One can separate these factors into: food safety (microbial, chemical), environmental, and animal welfare.

**Beef**

There are a number of regulations the EU enforces on the production of beef that may be in conflict with the regulations of potential partners of the UK. This section will highlight those on animal welfare and food safety measures.

The inequity between EU directives and regulations of third countries regards the treatment of calves22. This law constrains the isolation of calves over a certain age, the directive also enforces a certain size for individual and group pens and enforces the pens have open barriers as opposed to solid ones. Accommodations must be made to ensure the calves’ wellbeing, such as lighting, temperature air conditioning, qual ity, and humidity, hygiene. Inspections are required of accommodation quality and the health of calves. The European Commission found that there is no similar directive on the welfare of calves in the countries of Brazil and Argentina18, both countries that are in our list of potential trade partners. The US, whilst providing most of the same regulations as the EU, offers no regulation against unnecessary isolation of calves and no specific minimum space for animals other than decreeing that space must allow animals to care for themselves. So, those with concerns regarding the consumption of beef that has significantly harmed the welfare of young animals may disagree with increased importation of beef from these sources, particularly from Brazil and Argentina.

The US has been criticised for its different and low food standards regarding beef compared to the EU21 in meat. One different standard is the allowance of the use of synthetic growth promoting hormones in beef. Although allowed in the US, the EU has identified it as a safety concern and even implied its potential for increasing the incidence of breast and prostate cancer23. However, the EU ruling against growth hormones is not without controversy, not only has the US deemed it safe, but so has a joint FAO/WHO Expert Committee24. The WTO also argued that much of research highlighting the growth hormones is based on direct human consumption of the hormones as opposed to the residue left in the meat24. However, it would seem that the US still produces plenty of beef without the hormone for exports, since 5.8% of Dutch beef imports come from America. So, whilst the jury is out on the risks of growth hormones, there is still potential growth for trade with the US should the UK wish to import non-hormone-treated beef.

**Poultry**

For the US, poultry is even more problematic than beef as the chlorine washing of chickens is compulsory in the US and therefore unavoidable. The debate over whether chlorine washing is acceptable for consumption has already played out very publicly in trade comments by senior politicians in the US and the UK in July of 2017, however there is much misconception over the problems surrounding chlorine washing. Although public opinion believes the chlorine washing itself to be dangerous, believing the chlorine to be dangerous to ingest, the main problem with chlorine washing is how it allows other basic hygiene practices to be neglected: a concern if some error means the chlorination fails to do its job25.

The European Scientific Veterinary Committee in 1996 “expressed concern that the use of decontamination techniques during food processing would have an adverse effect on the efforts being made both at the primary production level and during the initial processing stages”, concerned that incentives for “good standards of husbandry and sanitation in the flocks” and “good manufacturing practice in the whole production line” would be removed26. EFSA wants to ensure good food standards from ‘field to fork’. Not only does this have a welfare aspect, in which chlorination removes the incentive for farmers to reduce livestock density and increase feed and water quality, but also a health aspect, firstly from the consequences following a failure of chlorination and the possibility for bacteria to spread to humans from the livestock. An EFSA BIOHAZ Panel found: “The public health benefits of controlling *Campylobacter* in primary broiler production are expected to be greater than control later in the chain as the bacteria may also spread from farms to humans by other pathways than broiler meat”27.

In summary, chlorine washing can be seen by many as problematic, primarily as it makes poor practices and standards further up the supply chain permissible and opens up a single point of failure, should the wash not be conducted appropriately. However, so long as measures can be taken to ensure that US imports have outcome equivalence, the regulatory in-equivalence shouldn’t be an issue. The conditions for use of lactic acid as a surface treatment for beef carcasses in the EU illustrates a potential compromise that allows regulatory equivalence – lactic acid is not a control but a supplementary treatment as the beef carcasses must be health marked (and therefore assessed as being fit for human consumption with all necessary controls having been applied) before lactic acid treatment.

Domestic farmers may have more economic concerns than safety concerns regarding the importation of chlorine washed chicken as it allows cheaper costs beforehand. Alongside economies of scale offered to US poultry operations, this contributes in helping make US chicken far cheaper than UK chicken. If cheap American chicken enters UK markets, poultry farmers may demand chlorine washing in UK abattoirs to allow domestic manufacturers to stay competitive.

Brazil may offer an alternative, considering the fact that it already exports large quantities of chicken meat to the Netherlands (Figure 4b) and thus is another source for non-chlorine washed chickens. Unfortunately, washed or not Brazilian chicken comes with its own problem of poor practices in the rearing of chickens. The European Commission suggests that there are no regulations against high-density farming or lack of air conditioning. This provides animal welfare concerns and also health concerns as higher densities means more diseases in the chicken meat produced.

**Pork**

Standards for animal welfare among pigs is high in Europe, for example measures against isolation, tethers, tail docking, reduction of corner teeth and other issues are present in the EU28 but not in the USA presenting a barrier to potential trade.

There is a lot of inequity between the regulations regarding pig feed in the UK compared to regulations in the US. According to a European Commission18, the EU requires the authorisation of particular additives to feed29, certain hygiene standards for packaged feed30, and prohibits the dilution of and use as a supplement of feed with excessive levels of undesirable substances31. For example, one significant issue is the use of the feed additive ractopamine. Banned in the UK, EU32, China, and Russia, ractopamine is still legal in the USA and Canada: both growth opportunities this study has named. It must, however, be raised that Canada permits far less use of ractopamine than the US33. Regarding the actual medical evidence surrounding ractopamine, the response is mixed. Although there is evidence that certain levels of intake can affect heart rate and other cardiovascular issues, making the consumption of such residues for those with cardiovascular diseases particularly dangerous. An EFSA safety evaluation attempted to establish an acceptable daily intake (ADI)34. However, the panel was unable to draw a conclusion as it couldn’t find the intake level of no observable effect. Erringon the side of caution the panel recommended enforcing an ADI of zero.

Another suggested point of issue is the washing of pig carcasses with lactic acid. Although this may seem similar to the chlorine issue, it is arguably more understandable. The EU already permits the washing of bovine carcasses with lactic acid, and the FSA has pushed in the past for the legalisation of washing even poultry carcasses with lactic acid35, therefore there doesn’t seem to be much reason to continue rejecting US or Canadian pork on the grounds of lactic acid washing.

**5 Conclusion**

Many International bodies such as the FAO and OECD believe that International trade underpins global food security. Trade has facilitated specialization, reducing food process and maximising productivity, and producers have invested in response to market signals raising outputs so that agriculture has kept pace with demand. Despite an explosion in the global human population, access to food has improved around the world. The share of world population with insufficient food supply fell from 52% in 1965 to 3% in 2005 – largely achieved through trade and not self-sufficiency.

The UK receives a large amount of its meat supply from European imports. Pork, beef, and poultry imports in particular are almost entirely sourced from EU27 states. It is observed that the Netherlands imports meat from countries outside of the EU through Rotterdam, and future trading arrangements could be made directly with these countries currently exporting to the EU via the Rotterdam Effect. It is likely that many approaches to closing any gaps arising from imports to the UK from Europe could require an increase in prices. Potential new world suppliers have lower costs, although accepting these imports would have major implications for the nature of trade agreements possible between UK & EU. Increasing domestic supply, would require a price rise, which would be worsened by the dependence of domestic supply on European labour. Continuing our supply from the European Union by staying in the EUCU, whilst part of the negotiated UK/EU withdrawal agreement, seems politically unlikely judging from parliamentary signals prior to the vote in early 2019. Any FTA with the EU would still result in a price rise, potentially due to currency exchange rate depreciation in the short and medium term. The only option for maintaining UK prices and supply, may be striking new trade agreements with third countries.

Analysis of new markets for meat imports to the UK shows that the USA and Canada would be suitable, in terms of capacity, for sourcing pork; the USA and Brazil for poultry; and the USA, Canada, Brazil and Australia for beef. This raises a number of regulatory issues since these trading partners may have different regulations in how they produce meats compared with current European and thus UK domestic regulations. In conclusion, the UK is a significant market in the Global Meat Trade, receiving large volumes of poultry, pork and beef from EU countries and lamb from countries like New Zealand. Brexiting the EU without a an agreement or a carefully managed exit , is likely to create new food trade challenges which will require economic and safety/standards consideration and could see new patterns of trade emerge. The use of global trade datasets offers an excellent way to analyse what future patterns might emerge and to help consider what regulatory and policy responses require consideration.

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**Figure captions**

Figure 1a Share of international meat trade by country

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 1b Proportion of UK meat imports from international trade partners

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 2a % Share of pork sent to UK ($)

Sub heading: EU composite total = 99.8%

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 2b % Share of beef sent to UK ($)

Sub heading: EU composite total = 86.2%

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 2c % Share of sheep meat sent to UK ($)

Sub heading: EU composite total = 11.1%

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 2d % Share of poultry sent to UK ($)

Sub heading: EU composite total = 95.5%

(Label to others on the key) \*others is an aggregation of all those countries of origin contributing less than 0.5% of imports to our market

Figure 3a Major flows of meat imported to the UK from EU member states as a share of the exporters total exports of a similar kind and secondly as a share of the UK's total imports of that meat importer for demand to the importer's dependence on the exporter for supply

Figure 3b Comparison of the UK's current importation of each type of meat from the EU with the total amount exported by QUAD countries to countries other than the UK

Figure 4a Non-EU sources of Dutch Beef Imports ($)

Figure 4b Non-EU sources of Dutch Poultry Imports ($)

Figure 5 Total value of selected products from selected non-EU countries export currently offering major sources of meat products for Dutch importation compared to the value of the product the UK imports from the EU. The graph is intended to see whether a particular country has the export capacity to replace the EU as a major trading partner following Brexit